Chapter 7 Building, Cooling Water, Electricity, Air-Conditioning

7. 1 Linac

7. 1. 1 Building

This LINAC Building is used to accommodate the main body of the linear accelerator and large electric power high frequency devices. The function that the radiation of the beam and the high-frequency electromagnetic wave from the occurrence devices should be sufficiently shielded is necessary. Also, we become needed to have the inside arrangement structure that is able to transmit high-frequency large electric power to the accelerator main body, without reducing the shield function.

a. Main Tunnel

Because voluminous concrete becomes necessary with the shield effect only by the concrete, the main body of LINAC is settled in the underground tunnel, and even the shield effect of the soil to the safe security to the person is used. The radiation level in the face of the concrete wall outside and soil contact is prescribed by the value that evaluated the influence to the soil and subterranean water. Concrete thickness was decided by the calculated the value with radiation and soil pressure. The detail of calculation is described in the section about radiation safty. The wall thickness of down stream part is decided in the radiation level and that of the up stream part is decided in soil pressure under ground. The accelerator main body is settled in almost center of the tunnel section. The plumbing and rack are arranged to the right side toward the lower stream and the pathway is arranged the left side. Then the entrances approach from left side and utility tunnel pit comes down from right side. The main tunnel has two large pits for device installation, two personal entrance gate and one emergency door. The main tunnel plane is shown in fig.7.1.1-1, 2, 3.

b. SubTunnel

The sub tunnel is established to ease the work of wave-guide settlement and to make bending structure that suppresses the radiation level. This sub tunnel is managed lower pressure, to have the function as the buffer for the radiation air leakage detection of the main tunnel. The size and the position of this sub tunnel was decided by the survey of streaming reduction effect and by cost with many kind of structures. The sub tunnel has one personal entrance gate and four emergency doors. The sub tunnel plane is shown in fig.7.1.1-4, 5.

c. 1st Floor

1st floor consists of the klystron gallery, cavity assembly room, electricity yards, magnet power supplies room, cooling water room and helium liquefaction device room. The klystron gallery is right above the main tunnel, and mutual position between klystrons and accelerator cavities are rather rigid. For the maintenance of klystrons, large scale crane is equipped in the klystron gallery. High voltage power lines from HP-PS room to each klystron are laid through large racks and pits. Especially at the injector section, DTQ magnet power supplies have huge number of bus-ducts to the main tunnel. The spatial filling rate is very high. The 1st floor

plane is shown in fig7.1.1-6, 7.

d. 2nd Floor

Accordingly, a part of the equipment that was not able to accommodate it on 1st floor would be established on the 2nd floor. It is electricity trans-yards and a part of the cooling water equipment that treats the radiation water. The 2nd floor plane is shown in fig.7.1.1-8, 9.

7. 1. 2 Cooling Water

The cooling water system consists of five parts. Fundamentally, it is divided into up-stream region and down-stream region. And each part has radio-active water circulation and non-radio-active water circulation. Furthermore, there is the circulation through iron metal devices in the up-stream region. The 1st priority of the design concept of the cooling water system is reduction of outer turbulence. To achieve high quality stability, basic design was done, under the assumption that always the heat load from accelerator is constant. Then we optimized in the system scale and convergence time, in quest of the response function of start-up. The change of accelerator operation parameter must be identified as the cooling water system parameter and the response function. Accordingly, it does not adjust the cooling water temperature with the closed control system that was separated with the accelerator.

There is special requirement at the RFQ. Initially, or restarting, RF power could not come into RFQ because the resonance frequency is shifted by temperature is too low. It was demanded that the influence of the temperature is supplemented with the adjustment of the cooling water temperature control. The cooling water flow line is shown in fig.7.1.2-1.

7.1.3 Electricity

Electricity of LINAC is about 34MW. 6.6kV line comes from ultra high-voltage power station, and it received at three trans-yards of LINAC building. Recently, the switching regulator becomes standard of high power source. Especially, DTQ pulse magnet power supplies must be separated other power lines, and var compensation. We separated the trans for the DTQ pulse magnet power supplies with other trans, and take balance of phase shift connection, and static var compensation circuit is studying.

Earthing concept is discussed. Single earthing method is not necessarily effective with high power electricity for klystron power supplies that concludes various frequency components, and spatially distributed. Earth of high power circuit and it of signal circuit are separated, and established under the klystron gallery by long laid cupper plates.

7.1.4 Air-Conditioning

Air-conditioning system is drived in closed loop when accelerator is operating. Concept of design of air temperature control system is the same as cooling water system. It is important to eliminated the influence from the outside as much as possible. Output temperature should be constant independently outside climate. The effect of changing accelerator operation must be appeared and controlled by the identified response function separated with noise effect.

The number of air outlets and flow speed optimized to keep temperature gradient in the tunnel, and rise time at starting up.

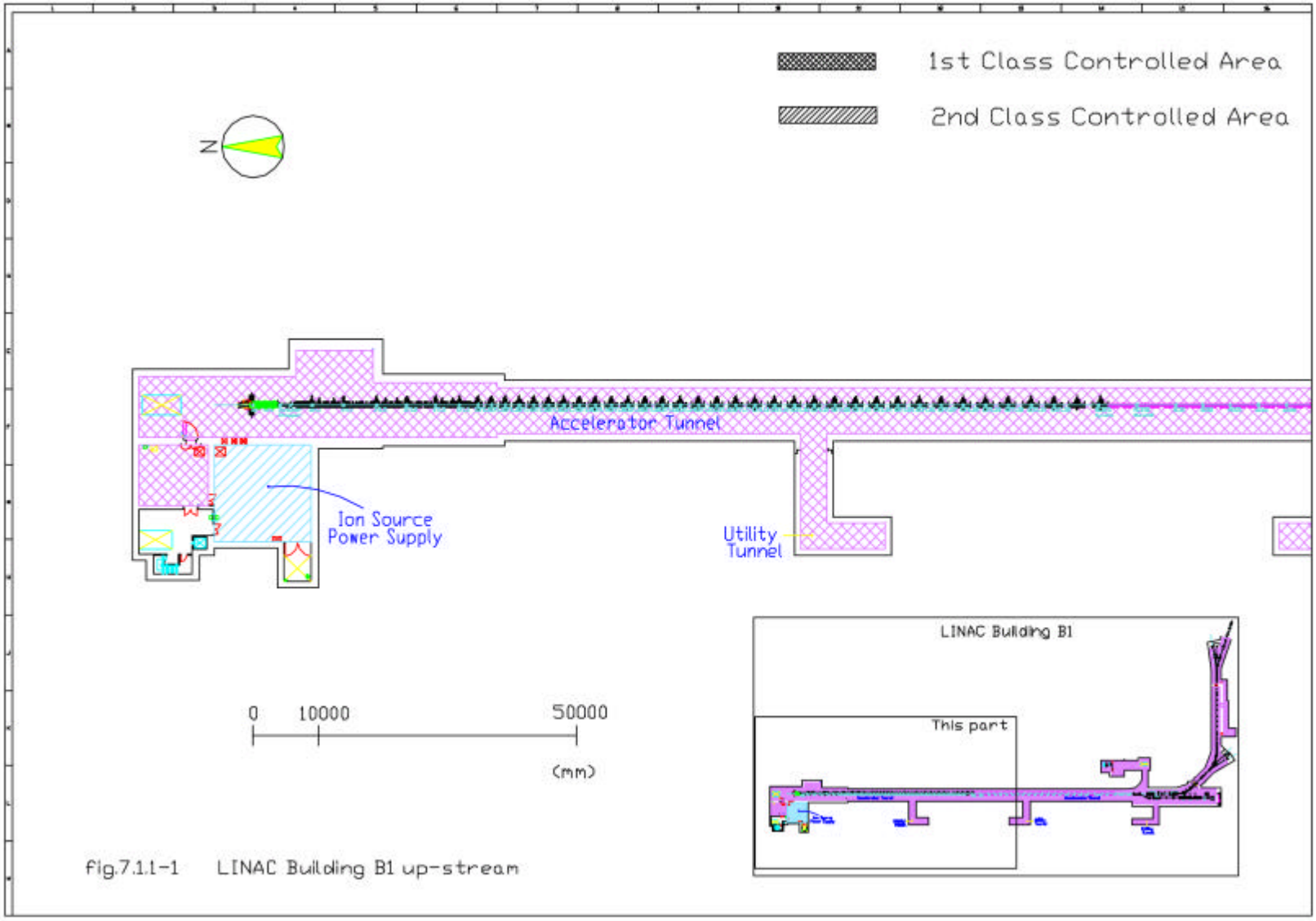

fig.7.1.1-1 LINAC Building B1 up-stream

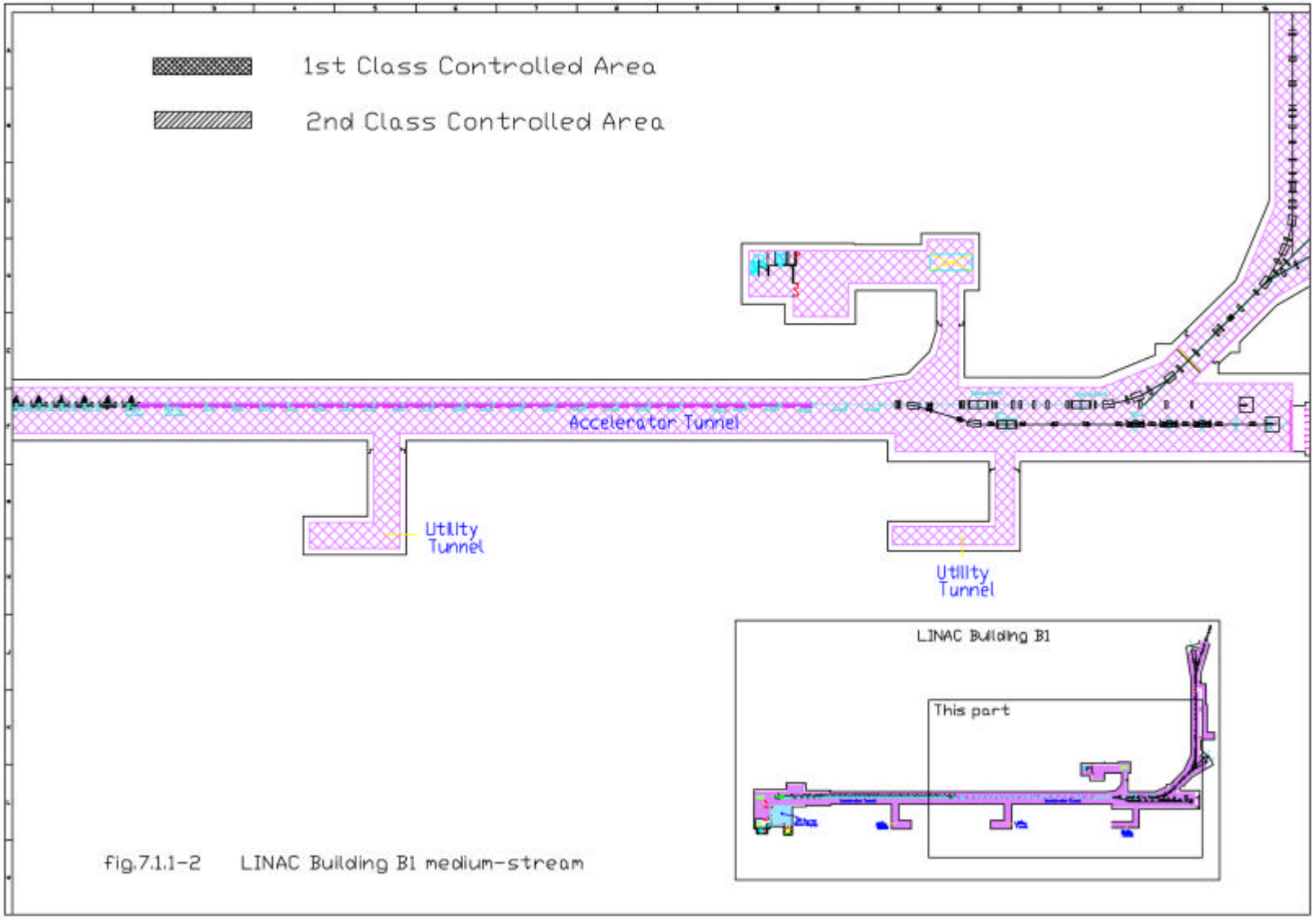

fig.7.1.1-2 LINAC Building B1 medium-stream

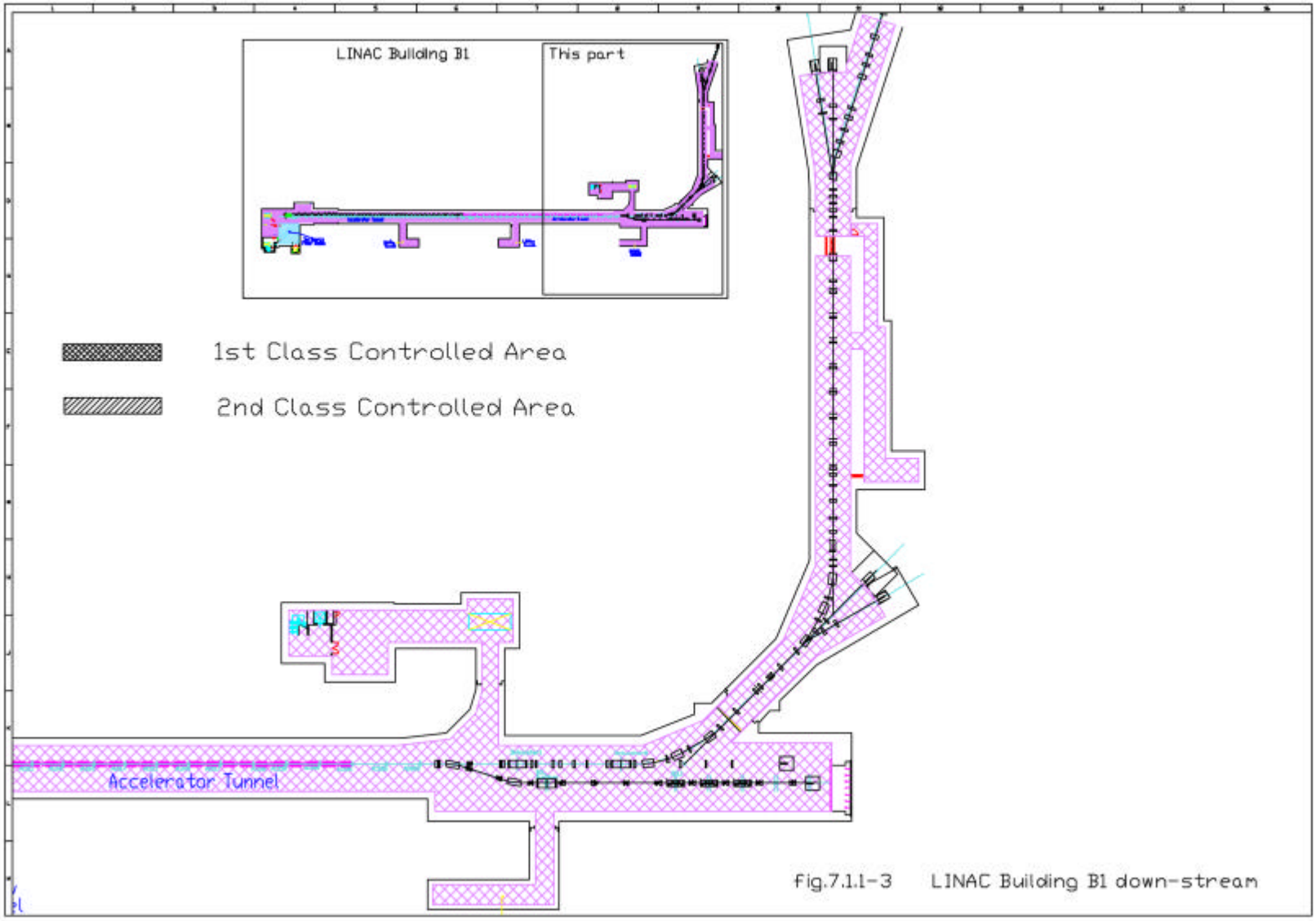

Fig.7.1.1-3 LINAC Building B1 down-stream

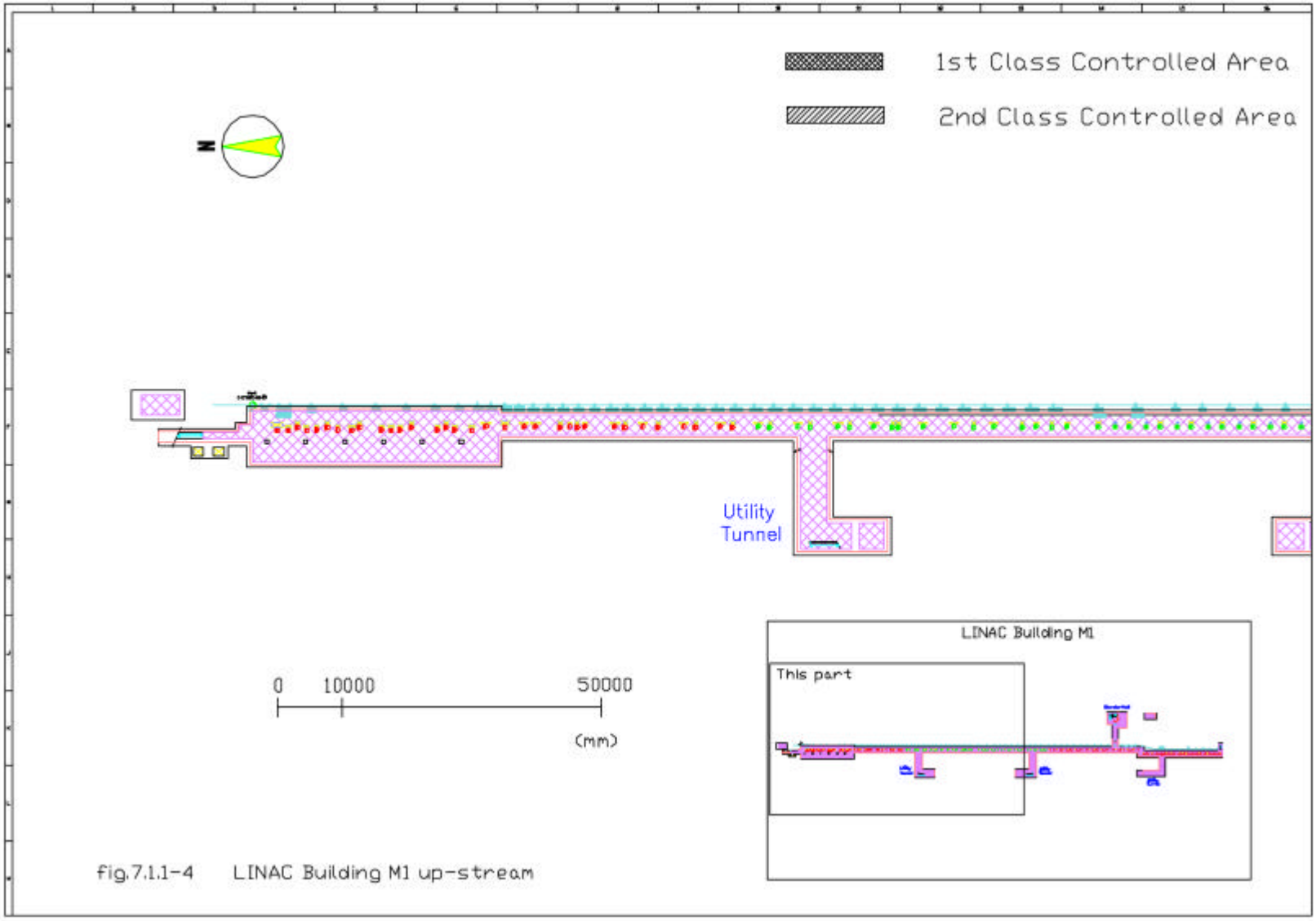

fig.7.1.1-4 LINAC Building M1 up-stream

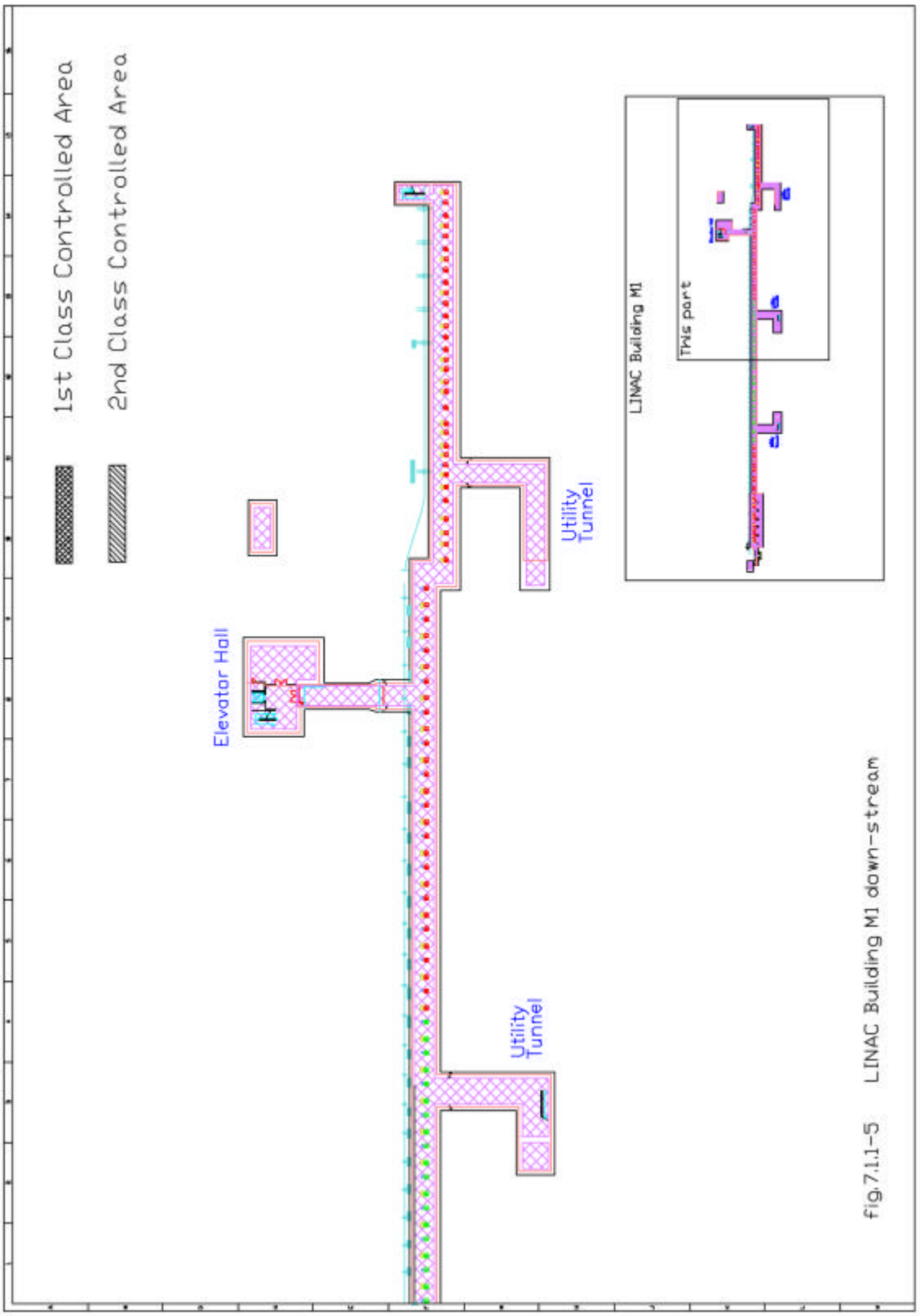

fig.7.1.1-5 LINAC Building M1 down-stream

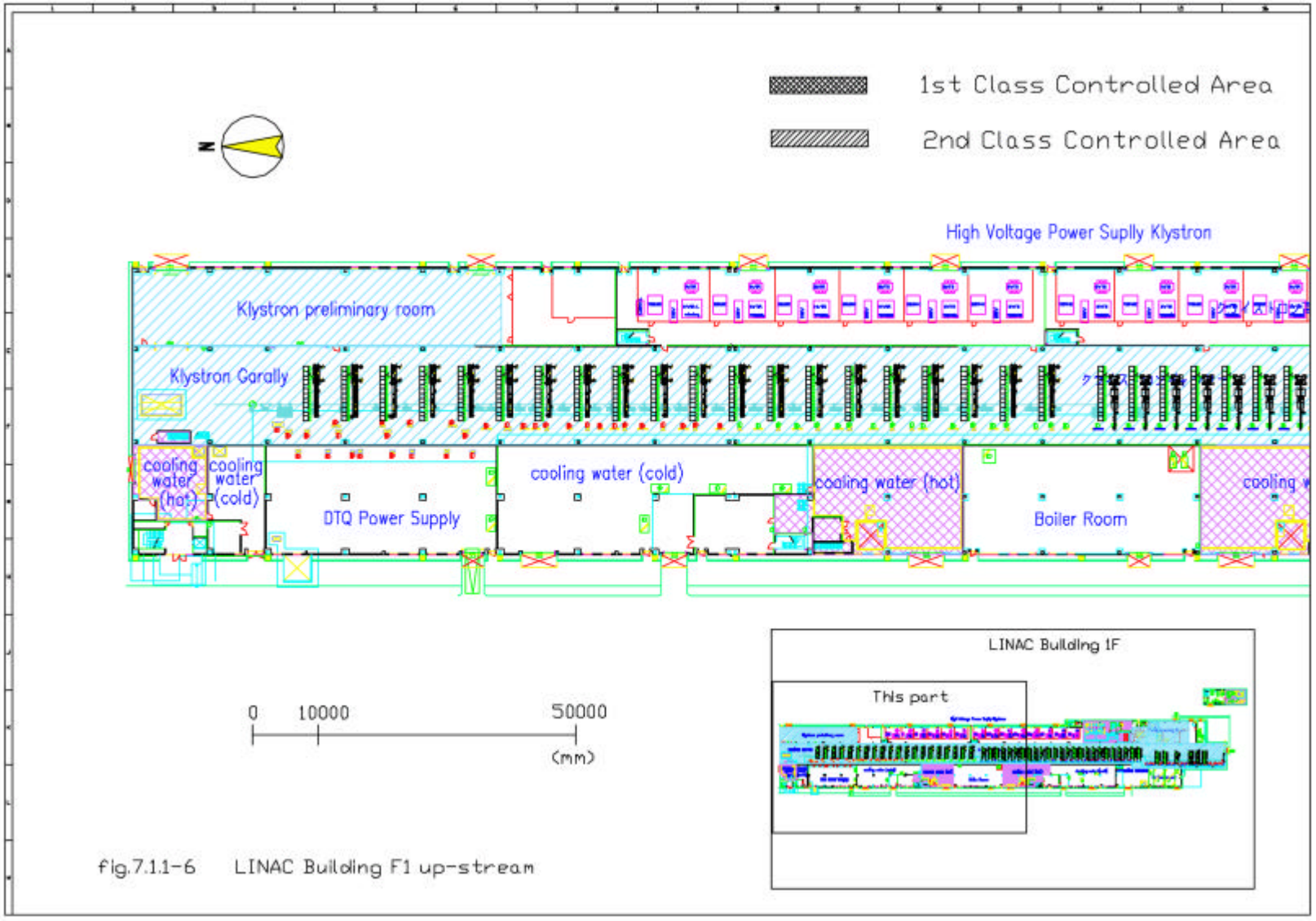

fig.7.1.1-6 LINAC Building F1 up-stream

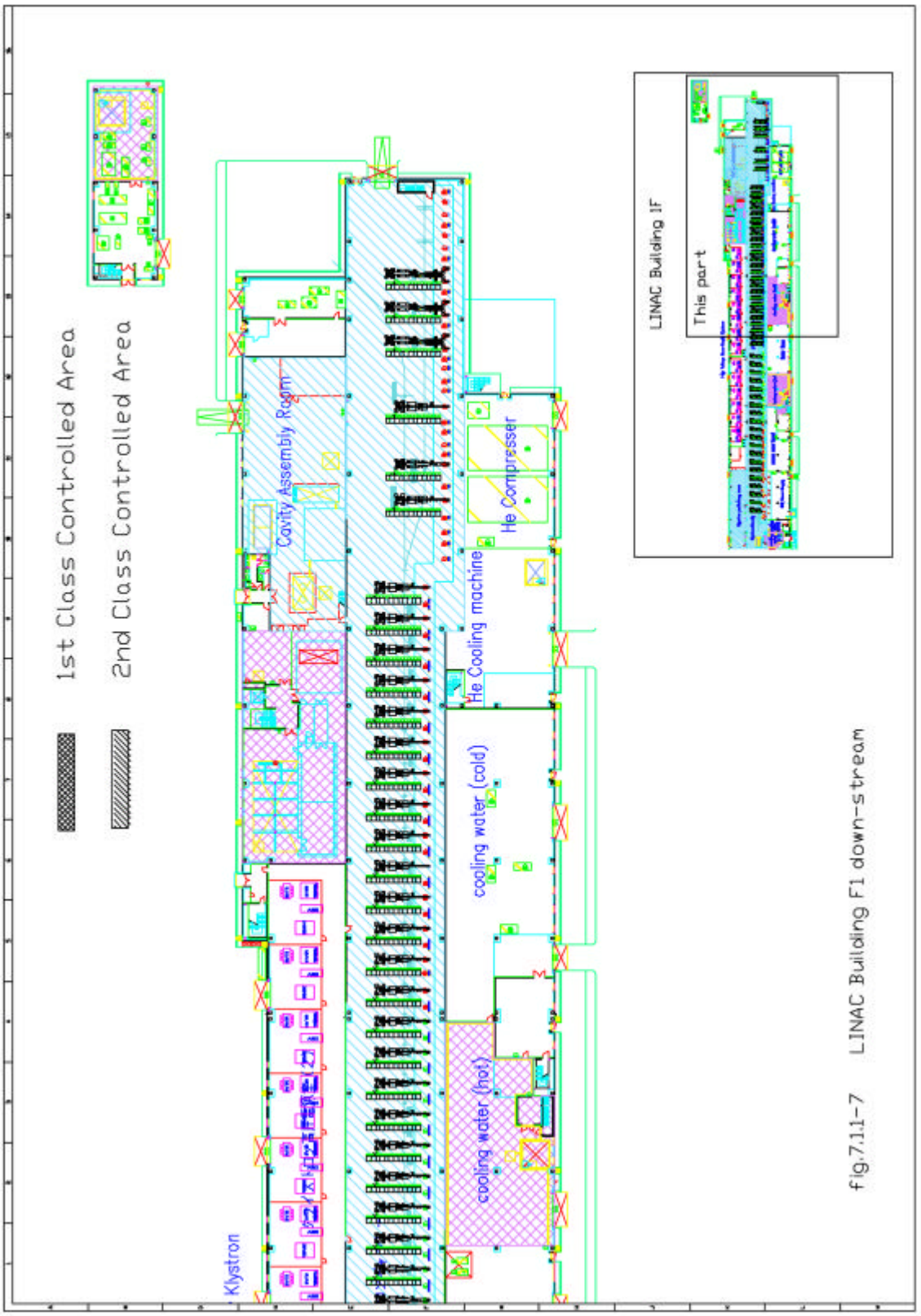

fig.7.1.1-7 LINAC Building F1 down-stream

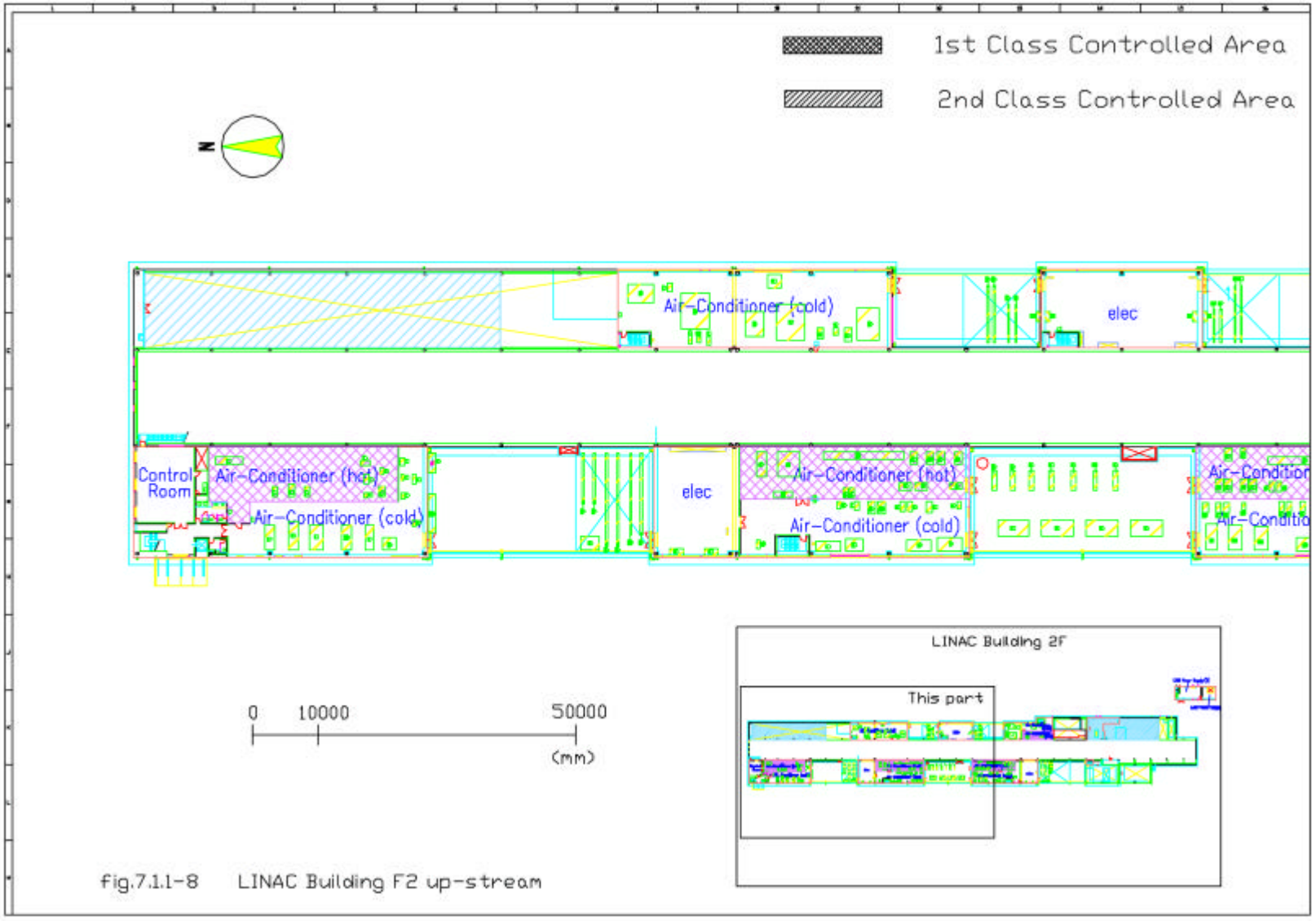

fig.7.1.1-8 LINAC Building F2 up-stream

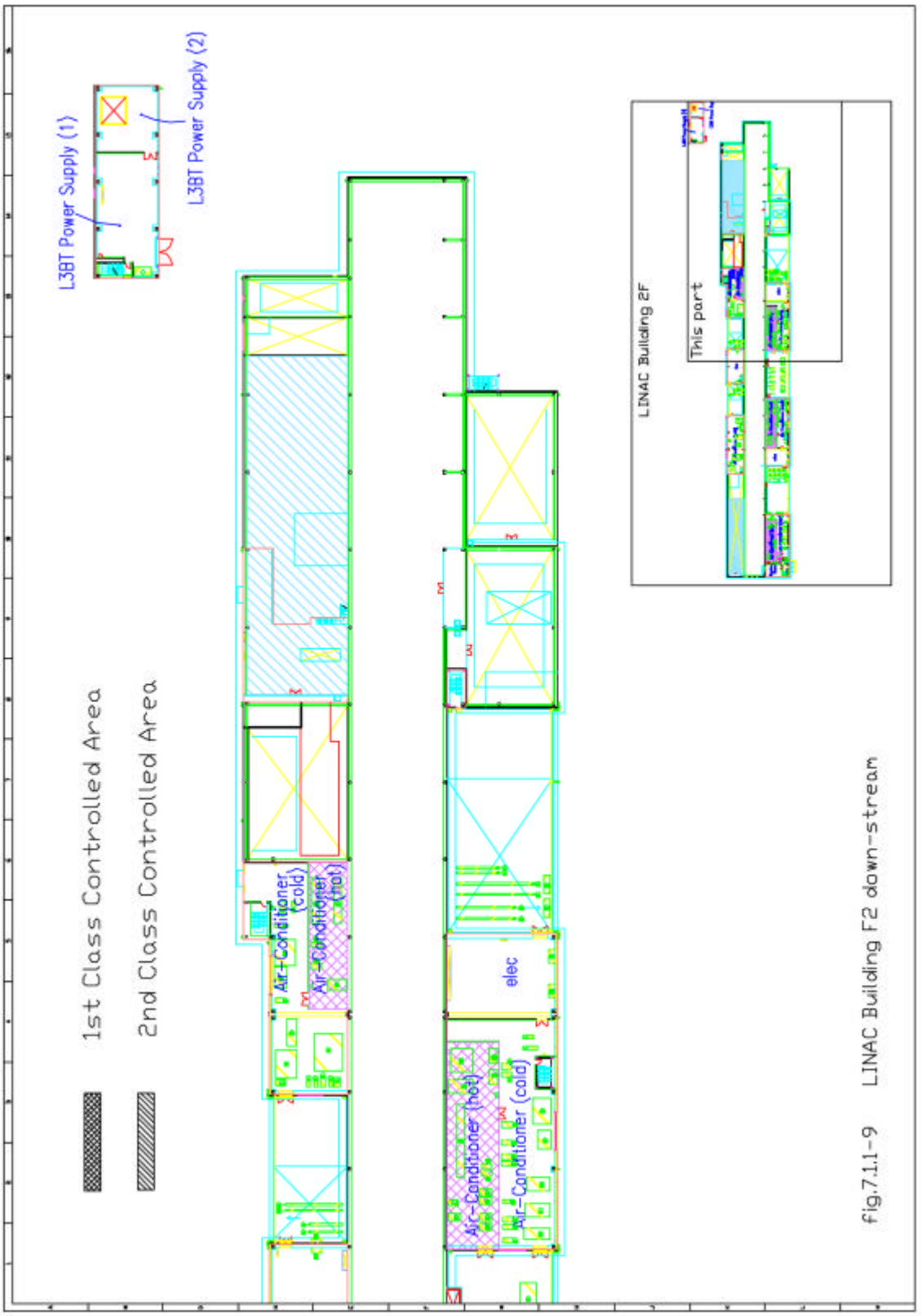

fig.7.1.1-9 LINAC Building F2 down-stream

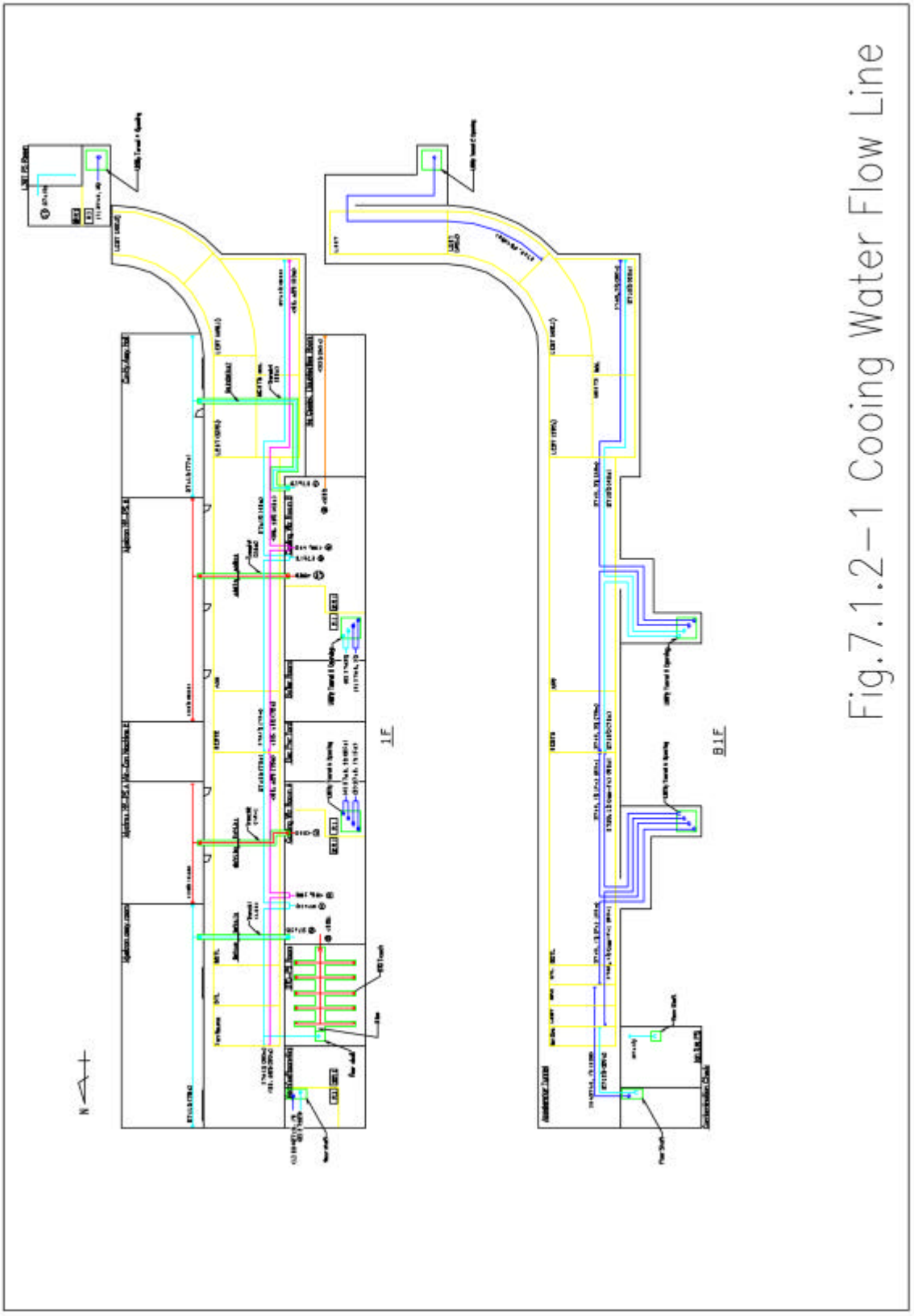

Fig.7.1.2−1 Cooing Water Flow Line